Microsoft, Apple and Xerox

The History of the Graphical User Interface

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There is an ongoing myth that Microsoft is justified in ripping off the Macs User Interface, because Apple had ripped off the MacUI from Xerox PARC (Palo Alto Research Center). Many go on to further say that Apple took the UI from the ALTO or STAR. Of course the people that say this have never used a Mac and an Alto or a Star, or they would know how silly these claims are.

I want to point out that philosophically and morally, theft by one does NOT justify the theft of another. If Apple did steal their UI from Xerox (which they did not), that would not forgive Microsoft of the same crime -- that would only make Apple guilty of a crime as well. So using this as a rationalization for Microsofts theft from Apple is void of any merit.

Apple and Xerox

Apple did not "rip-off" the Macs UI from Xerox. Apple had hired some people from Xerox (like Jef Raskin, Bruce Horn) who believed in concepts of a Graphical User Interface. These concepts are pretty broad -- like making a computer easier to use by using graphics (icons), using menus, windows and making a consistent interface to do things. The work on these concepts predates Xerox PARC -- in fact it was many of these peoples individual work on those concepts that got them hired at PARC. So Xerox (PARC) brought them together to refine them.

Apple's work on GUI's predates Steve Jobs visit to Palo Alto Research Center. Apple had already had the same broad goals of offering an easier to use computer, and possibly using some of the same concept (like menus, icons, and graphics).

Remember the following: Icons were not new, we had been using them for years for international street signs and so on -- they were only new on computers. Menus were not new, text based menus were being used and had been for a while. Graphics weren't new, though how much they were relied upon was new. The concepts of User Interface (Human Factors) was not new, it was just a little newer in applying it to computers.

Jef Raskin had worked at Xerox, and he was tooting the "easier to use" trumpet, with his vision of what that meant. He brought some of those ideas from Xerox, but he had brought some of those ideas TO Xerox as well. Later, he convinced Jobs to visit Xerox PARC, and Jobs became an immediate convert (for ease of use).

What Jobs saw at Xerox was a prototype Smalltalk development system. He did not see either a working ALTO or Star (which was developed much later).

Apple paid

Jobs was so hot on the concepts of UI, and the living Demos he say, that he, later, negotiated a deal with Xerox. He gave Xerox a large sum of stock in Apple (worth Millions) if he could come back, and bring some programmers -- to inspire them more on the concepts of GUI. This was like a one-day tour. This was agreed to by Xerox, and so by no stretch of the imagination could this be called "ripping-off".

PARC was a research center -- meant to inspire development. But they did not really develop products (in the commercial sense), they developed ideas. Saying that Apple learning some of the base concepts and then applying them was "ripping-off" is like saying that Air-Bags are ripping off Newton -- because Air Bags work because they adhere to some of the laws of physics first expressed by Sir Isaac. A silly silly argument. Knowledge builds on knowledge. Xerox didn't see Apple as competition, that is why they let them in -- but they charged Apple, since Xerox believed that their research had value.

Apple was creating a product, and so they hired some of the same researchers from Xerox, to be brought to Apple to work on the Mac and Lisa projects. Those researches state quite clearly that the goals and implementation were quite different between Xerox and Apple. The following is an exchange between two of those researchers, and should give you an idea of how much the Mac contributed to the concepts of UI -

- Letter from Bruce Horn on origins of Macs UI
- Response from Jef Raskin (another Mac founder)
- Response from Bruce to Raskins Letter

The letters do seem to agree that the Macs UI was created at Apple, by Apple and for Apple. And that little if any Xerox work was taken, and the Mac was in a completely different universe. Some broad concepts were in common, but that is about it. Apple furthered those concepts, developed their own, and had totally different implementations.

The differences in UI between the Xerox UI and Apples' Mac were startlingly different. Years ago I saw a demo of a Alto. From my memory (which may not be flawless), it had a 3 button mouse (which you operated with your right hand), and a chording keyboard (for the left hand). There were overlapping windows, but there was no direct manipulation of those windows. To move the window you selected an option, from the one Menu that you had for each window, and you entered the new size or location of the window into a dialog (using numerical coordinates).There were icons, but icons were not associated with files -- they were more actions (buttons). They were using icons as verbs (do this, or do that) -- Apple made them into nouns, objects (that each represented data) that you manipulated. There wasn't that much direct manipulation, and most of the usage of the multiple windows was so that you could have multiple character terminals (like DOS) open at the same time. Contrast this with a Mac and you see that Apple went way way beyond what they saw.

Xerox extended their developments over time as well, but this is not ripping off. After Apple was far along into the Lisa and Mac project, Xerox had the Star. The Star used many more Mac-like concepts. But many were parallel developed, and some was cross over -- but both machines were developed at the same time but for different goals. I also beleive the Mac is easier to use and has the better interface.

Contrasts

Jobs kept beating on the Mac people that "Real Artists Ship!" - and that they were making a product. That is not anything like the research atmosphere at Xerox.

The Mac was 128k based personal computer, based on a Motorola 68000 processor - the MacOS was designed around Pascal with lots of assembly language for size/speed.

The Xerox machines were anything but personal computers -- they did not use microprocessors (closer to mini-computers), they had no real resource constraints as the Mac did, they ran slower (in real use), were far less elegant, were very immature (yet had some brilliant concepts) and were not really products -- they were research tools. The Xerox Machines were built around SmallTalk (a very resource wasteful language, for the time, but dynamic and powerful).

The two machine use completely different code and architectures -- which requires completely different software designs. The Mac and the Alto are about as related as a Motorcycle and a Semi-truck -- sure they both have wheels, both are transportation, and both run on roads -- after that it gets pretty divergent.

Note: There is not a single line of code that Apple got from Xerox, nor could have since the languages and designs of the system were so radically different.

Apple and Microsoft

Now what happened with Microsoft?

Well it starts out that Microsoft was one of the first Application Developers for the Mac. Apple (Jobs) knew that the Mac needed Software to be commercially viable, and Jobs learned that Microsoft was trying to break in to the Application market (1).

(1) Few remember that MS made languages. Then later stole OS's (DOS). And it wasn't until the Mac that they started making Applications. The Mac was Microsoft's chance to break into the lucrative Application markets. (Microsoft had made a few feeble attempts before the Mac, but it was the Mac that made them successful in the application area. They knew that a new computer meant new opportunities.

Jobs showed Microsoft the early Mac prototypes. Gates liked the ideas and agreed to write Mac applications.

Gates later threatened to pull their apps at the last minute before release unless Jobs agreed to -

A) Apple had to license some of the MacUI for MS-Applications on the PC. This Application suite later grew into Windows 1.0 and Office. Remember, Windows started off as an Application Suite, not an OS-Shell (2).

(2) Because Apple had licensed some concepts to Microsoft (under coercion), it weakened their case later against MS when MS started more blatantly ripping off the Mac. Contrary to popular myth that Apple lost their lawsuit against MS because it wasn't a rip-off, the real reason was that they had been to vague in their licensing of some technologies, and the benefit of the doubt was given MS.

B) Apple had to drop their MacBasic project which was completed and better than MS Basic. MacBasic had many concepts that MS ripped off to create VisualBasic. What few ideas for VB that MS didn't rip off from MacBasic they got from HyperCard -- which Bill Atkinson wrote because the Mac didn't have a good simple programming environment, because MS had dropped their basic for the Mac and had forced MacBasic to canceled as well.

Later MS decided that the GUI was just too cool not to use. So they started on an Application Suite that would use the Macs concepts of Windows, a Mouse, and direct manipulation to achieve its ends. This became Windows 1.0, and evolved into the Windows we know and hate today. The lead programmer for the Windows project was the same guy who had been a lead programmer for writing the Mac Application projects.

This sequence of events (Microsoft "borrowing" the Mac interface) is not the same as taking rough concepts and adding to them to create your own system -- this is much more intimate than that. Microsoft took their best Mac Programmer, and had him making almost every design decision for early windows. He was told, by Bill Gates, to make a PC look and work, "JUST like a Mac" -- this is a direct quote from Gates! Contrast that sequence of events, to Apple and Xerox sequence of events, and you get an idea for the difference in philosophy and implementation. Microsoft stole, Apple expanded.

This similarity was (of Windows to MacOS) is not just in design, there are whole toolboxes/API that are almost identical (in interface). Microsoft stole data structures and many routines, and the names and concepts for many things are the same as well. If it wasn't for the fact that they had to hack their stuff on top of DOS, they likely would have just stolen all the same code (and they did get sued for that later as well). If you look at many of the older Windows routines you see names and structures that are identical to the Mac. But MS is smart enough to avoid (or win) lawsuits -- they changed one name out of 10, or re-ordered a few things, all so they could say it wasn't identical. MS also had to make some design changes to get it to run on a PC. But as far as real design work for Windows, there was none -- the Mac was a living design document.

At first, MS only ripped off the design and implementation, but stayed away from Apple's look and feel. They knew that Apple would only tollerate so much theft. Later MS crossed this line as well, and Apple sued. It was when they started to steal the desktop metaphor (folders, trashcan, etc.) that Apple had enough. No matter what the legal decisions are, ethically Microsoft ripped off the Mac.

Later (post 1995) Microsoft has started to put some money into R&D, and they may try to innovate. Up to this point, they did not innovate -- they may rework others ideas, or add features to, but that's not "true" innovation.

Conclusions

Apple did not rip-off the Alto (Xerox-Parc) -- how could they? Apple was a product oriented company that produced a computer on their own. That computer had a few similarities in concept (user interface) with stuff Xerox was doing, but almost NOTHING in common design or implementation. Apple's metaphors went way way beyond what Xerox was doing (though there are other areas where Xerox was beyond Apple). They were trying to achieve different goals -- and from different points of view. Apple was creating the ultimate personal computer. Xerox was doing research tools, and later tried to make a big client-server type document distribution systems. These are about as similar as a motorcyle and a commuter Bus.

Microsoft on the other hand did rip-off Apple. The concept of making a computer easy to use is way to broad to protect, and Apple didn't complain about that. Windows, icons and menus are not ripping Apple off either -- these are broad concepts. Microsoft got sued because they stole design, implementation and finally metaphors (look and feel). They stole the way you manipulate things on the computer -- as well as almost everything underneath. I sometimes swear that if Microsoft had an original thought the company would immediately implode in suprise. Almost Everything good in Windows can be traced directly to the Mac (which the Mac had years before) -- and almost everything bad in Windows can be traced directly to where MS tried to do things different than the Mac and proved they don't know what they hell they are doing.

Letter from Bruce Horn on origins of Macs UI

Xerox, Apple and Progress

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Any number of people will try to tell you about the origins of the Macintosh, but Bruce Horn was one of the people who made it happen.

From 1973 to 1981, Bruce was a student in the Learning Research Group at Xerox, where Smalltalk, an interactive, object- oriented programming language, was developed. While there, he worked on various projects including the NoteTaker, a portable Smalltalk machine, and wrote the initial Dorado Smalltalk microcode for Smalltalk-76. At the Central Institute for Industrial Research in Oslo, Norway, in 1980, he ported Smalltalk- 78 to an 8086 machine, the Mycron-2000.

At Apple (1981-1984), Bruce's contributions included the design and implementation of the Resource Manager, the Dialog Manager and the Finder (with implementation help from Steve Capps). He was also responsible for the type Framework for documents, applications, and clipboard data, and a number of system-level design decisions.

Since then, Bruce consulted on a variety of projects in the late 1980's at Apple and received a Ph.D. in Computer Science from Carnegie-Mellon University in 1993. He continues to work as a computer science consultant with Apple and other companies.

Where It All Began

For more than a decade now, I've listened to the debate about where the Macintosh user interface came from. Most people assume it came directly from Xerox, after Steve Jobs went to visit Xerox PARC (Palo Alto Research Center). This "fact" is reported over and over, by people who don't know better (and also by people who should!). Unfortunately, it just isn't true - there are some similarities between the Apple interface and the various interfaces on Xerox systems, but the differences are substantial.

Steve did see Smalltalk when he visited PARC. He saw the Smalltalk integrated programming environment, with the mouse selecting text, pop-up menus, windows, and so on. The Lisa group at Apple built a system based on their own ideas combined with what they could remember from the Smalltalk demo, and the Mac folks built yet another system. There is a significant difference between using the Mac and Smalltalk.

Smalltalk has no Finder, and no need for one, really. Drag-and- drop file manipulation came from the Mac group, along with many other unique concepts: resources and dual-fork files for storing layout and international information apart from code; definition procedures; drag-and-drop system extension and configuration; types and creators for files; direct manipulation editing of document, disk, and application names; redundant typed data for the clipboard; multiple views of the file system; desk accessories; and control panels, among others. The Lisa group invented some fundamental concepts as well: pull down menus, the imaging and windowing models based on QuickDraw, the clipboard, and cleanly internationalizable Software.

Smalltalk had a three-button mouse and pop-up menus, in contrast to the Mac's menu bar and one-button mouse. Smalltalk didn't even have self-repairing windows - you had to click in them to get them to repaint, and programs couldn't draw into partially obscured windows. Bill Atkinson did not know this, so he invented regions as the basis of QuickDraw and the Window Manager so that he could quickly draw in covered windows and repaint portions of windows brought to the front. One Macintosh feature identical to a Smalltalk feature is selection-based modeless text editing with cut and paste, which was created by Larry Tesler for his Gypsy editor at PARC.

As you may be gathering, the difference between the Xerox system architectures and Macintosh architecture is huge; much bigger than the difference between the Mac and Windows. It's not surprising, since Microsoft saw quite a bit of the Macintosh design (API's, sample code, etc.) during the Mac's development from 1981 to 1984; the intention was to help them write applications for the Mac, and it also gave their system designers a template from which to design Windows. In contrast, the Mac and Lisa designers had to invent their own architectures. Of course, there were some ex- Xerox people in the Lisa and Mac groups, but the design point for these machines was so different that we didn't leverage our knowledge of the Xerox systems as much as some people think.

The Hardware itself was an amazing step forward as well. It offered an all-in-one design, four-voice Sound, small footprint, clock, auto-eject floppies, serial ports, and so on. The small, portable, appealing case was a serious departure from the ugly- box-on-an-ugly-box PC world, thanks to Jerry Manock and his crew. Even the packaging showed amazing creativity and passion - do any of you remember unpacking an original 128K Mac? The Mac, the unpacking instructions, the profusely-illustrated and beautifully- written manuals, and the animated practice program with audio cassette were tastefully packaged in a cardboard box with Picasso- style graphics on the side.

Looking Back

In my opinion, the software architectures developed at Xerox for Smalltalk and the Xerox Star were significantly more advanced than either the Mac or Windows. The Star was a tremendous accomplishment, with features that current systems haven't even started to implement, though I see OpenDoc as a strong advance past the Xerox systems. I have great respect for the amazing computer scientists at Xerox PARC, who led the way with innovations we all take for granted now, and from whom I learned a tremendous amount about software design.

Apple could have developed a more complex, sophisticated system rivaling the Xerox architectures. But the Mac had to ship, and it had to be relatively inexpensive - we couldn't afford the time or expense of the "best possible" design. As a "little brother" to the Lisa, the Macintosh didn't have multitasking or protection - we didn't have space for the extra code or stack required. The original Macintosh had extremely tight Memory and disk constraints; for example, the Resource Manager took up less than 3,000 bytes of code in the ROM, and the Finder was only 46K on disk. We made _many_ design decisions that we regretted to some extent - even at the time some of us felt disappointed at the compromises we had to make - but if we had done it differently, would we have shipped at all?

The Past and Future

In many ways, the computing world has made remarkably small advances since 1976, and we continually reinvent the wheel. Smalltalk had a nice bytecoded multi-platform virtual machine long before Java. Object oriented programming is the hot thing now, and it's almost 30 years old (see the Simula-67 language). Environments have not progressed much either: I feel the Smalltalk environments from the late 1970's are the most pleasant, cleanest, fastest, and smoothest programming environments I have ever used. Although CodeWarrior is reasonably good for C++ development, I haven't seen anything that compares favorably to the Smalltalk systems I used almost 20 years ago. The Smalltalk systems of today aren't as clean, easy to use, or well- designed as the originals, in my opinion.

We are not even _close_ to the ultimate computing-information- communication device. We have much more work to do on system architectures and user interfaces. In particular, user interface design must be driven by deep architectural issues and not just new graphical appearances; interfaces are structure, not image. Neither Copland nor Windows 95 (nor NT, for that matter) represent the last word on operating systems. Unfortunately, market forces are slowing the development of the next revolution. Still, I think you can count on Apple being the company bringing these improvements to next generation systems.

I'm sure some things I remember as having originated at Apple were independently developed elsewhere. But the Mac brought them to the world.

Response from Jef Raskin (another Mac founder)

RE: Xerox, Apple and Progress
      Response to Bruce Horn's letter
By: Jef Raskin (JefRaskin@aol.com)

Many people have sent me copies of Bruce Horn's (attached after this message for your easy reference) comments on the sources of the design of the Mac, asking my thoughts on them. I thank you all for sending me Bruce's essay and hope you enjoy some further information.

I read Bruce Horn's recollections of the Macintosh project with some interest. Horn arrived at Apple in 1981 after the Macintosh project had been running about two years. I started working on it in early 1979, presented it to Make Markkula about March of that year; it became an official project in September. From the chronology, it is clear why Horn doesn't have (as he is careful to say) first-hand knowledge of where many of the original ideas came from, this note can fill in a few details.

My primary role in this matter was to create the Macintosh project. I named it for my favorite kind of eatin' apple, the succulent McIntosh (I changed the spelling of the name to avoid potential conflict with McIntosh, the audio equipment manufacturer). There have been, as Horn points out, many inaccurate recountings of the early Mac history. The best I've seen (they guy did some heavy-duty research) is Owen Linzmeyer's "The Mac Bathroom Reader". My own history of the Mac (entitled "The Mac and Me") is currently being serialized in the Computer Historical Association of California's journal.

Other articles of mine that might interest readers of this:

Two articles that address interface issues:

* Down With GUIs!
      Wired, December 1993, pg. 122
* Intuitive Equals Familiar
      Communications of the ACM. 37:9 September 1994 pg. 17

Two articles that address historical matters:

* Holes in the Histories"
      Interactions 1.3, July 1994 pg. 11
* Hubris of a heavyweight. A review of Steve Jobs &t he NeXT Big Thing
      Randall E. Stross." IEEE Spectrum, July 1994 pp. 8-9

Horn is correct that click-and-drag methods were invented at Apple and not at PARC (or elsewhere, as far as I know). I created this method for moving objects and making selections after finding the Xerox click-move-click method prone to error. Bill Atkinson extended the paradigm to pull-down menus. This all happened relatively early in the history of the Mac. The way my insight got extended by Bill was typical of how things developed then. Surprising as it may seem in retrospect, there was some resistance to my new way of using a graphic input device and I had to repeatedly explain how drag worked and why it was often easier to use than the modal click-move-click technique developed first (as far as I know) on the Sketchpad system and then used at Xerox PARC. Some of the arguments I used involved looking at number of user actions and the time they took, an approach that was then or would soon become the very useful GOMS model of Card, Moran, and Newell. Bill was a strong supporter of my ideas and at one session where I was explaining how drag worked Bill, by way of amplifying how useful it was, said something like, "And you can use it to open menus, just put the cursor on the top and drag down to the item you want."

I hired Bill for Apple, inviting him up from UCSD, where he had been a student of mine. His close friend Bud Tribble, another UCSD student I knew, joined us. Later still Bud was to lead Software development at Next.

Trying to untangle the history is sometimes hard, as in my reference to the work of Card et. al. To see what I mean, here's a bit of background: I had been, in the early 70's, a professor and computer center director at the University of California at San Diego and a Visiting Scholar at the Stanford Artificial Intelligence Laboratory (SAIL) at the now-demolished D.C. Power Laboratory (named for a Mr. D. Power). When PARC was in its first few years I was often a visiting academic there, taking part in discussions and viewing with delight some of the developments going on there; I trust that people there also took pleasure in finding in me someone who was already on much the same user-interface wavelength. I didn't have to be sold on the idea that UI and graphcis were of primary importance to the future of computing. When I joined Apple in 1978 I stopped visiting PARC to avoid any possible conflicts of interest. Given these circumstances I could have learned from Stu Card, Tom Moran or others at PARC the basic ideas of GOMS style analysis, or I might not have run into that work during my visits to PARC. I don't remember, and unless I find something in my files about it someday or someone else recalls a significant event, I will never know if my primitive GOMS-style analysis that helped lead to Apple's adopting my click-and-drag methods was based on their work or not.

I was the 31st employee at Apple (joining in January, 1978), but I had first met Jobs and Wozniak in their garage in 1976, and told them of the wonderful work being done at PARC. Working on the Apple I at the time, they weren't interested in human factors. While I was the first PARC-savvy person at Apple, Larry Tesler was the first PARC employee to join the company. At first he was strongly opposed to the Mac's easier-to-use mouse methods, and I eventually wrote a memo that showed, point by point, that the one-button mouse could do everything that PARCs three-button mouse could do and with the same number or fewer user actions. It was faster and more efficient, and much easier to learn and remember how to use. I had observed that people (including myself) at PARC often made wrong-button errors in using the mouse, which was part of my impetus for doing better.

Horn makes it seem that the selection-based editor came with Tesler from PARC. It may have been a case of convergent evolution, since we already had that paradigm at the Mac project. In this case it dates at least back to an editor I designed much earlier, while at Bannister &amp; Crun. In '73 I discussed my editor concepts with many people at PARC, so I do not know whether Tesler's design was influenced by my work, I know it was not the other way around.

My thesis in Computer Science, published in 1967, argued that computers should be all-graphic, that we should eliminate character generators and create characters graphically and in various fonts, that what you see on the screen should be what you get, and that the human interface was more important than mere considerations of algorithmic efficiency and compactness. This was heretical in 1967, half a decade before PARC started. Many of the basic principles of the Mac were firmly entrenched in my psyche. By the way, the name of my thesis was the "Quick-Draw Graphics System", which became the name of (and part of the inspiration for) Atkinson's graphics package for the Mac.

Thus Horn is more correct than he knew when he wrote that the world has generally overestimated the influence of PARC on the Mac, as even some of the concepts that he attributes to PARC's influence predated PARC.

When Bruce Horn discusses the Hardware, and attributes the overall concept for the design to Jerry Mannock (who indeed did a world-class job on the final design of the box). Horn is unaware that the requirements for a small footprint, unique aesthetic, built-in Sound, etc. were all part of the project specs from the very beginning, long before Mannock joined the team. I still have drawings (mostly by my long-time friend and fellow early Apple employee Brian Howard) starting in late 1979 that show these features. The built-in speaker and serial ports were merely carrying on the Apple II tradition. My design also had a bus extension port to allow additional Memory and other devices to be added, but Steve Jobs removed that feature. It returned with the SE.

Before creating the Mac project, I was Manager of Publications at Apple, and so for the Mac I was careful to insist that the excellence of the product extend, to use Horn's words, to "the unpacking instructions, the profusely-illustrated and beautifully-written manuals, ... tastefully packaged." Packaging was another major concern of mine; I had worked for a company in South San Francisco called "The Box Factory" where I had done box and display design. I did not work on the manuals or the box design myself, but I had put in place the systems and people who would do a first-rate job, and inculcated these values in Apple's management.

Horn and many other people who joined Apple long after the Mac and Lisa projects were well under way never knew the genesis of many of the ideas the were later to become prominent and widely copied. For example, he attributes the internationalization of the products to the Lisa group, but it actually began when I hired Joanna Hoffmann into the Mac group partially because of her international background and my interest in providing international fonts. I could go on for another few pages of similar small errors in chronology or attribution in Horn's remarks, but they are not of major importance (except perhaps to the people who did the work).

Time plays tricks on memory. By chance, I got to use a Xerox Star for the first time recently. It was in a room with a Lisa and an early Mac. I found the Star and the Lisa to be incredibly slow and somewhat clumsy to use; the Mac was far faster and more fluid (a tribute to Horn and his associate's efforts!). The speed differences were real, but it could be that my familiarity with the Mac accounts for the feeling of clumsiness with the Star and Lisa. I suspect if Horn were to go and use a Star today, he would not be quite so enthusiastic about how "advanced" it was, at least from a user's point of view. Of course, he might well be correct when speaking from a programmer's point of view. However, I've always been more concerned with users. Programmers do their work but once, while users are saddled with it ever thereafter.

I find looking at the past not nearly as interesting as looking into the future. As Horn says, and as I have written in a number of articles, things haven't changed as much as the hype would have it. I think that years from now, when the details have been washed away by the acid rains of time, four major commercial events will stand out in the history of personal computers: the advent of the microprocessor which drove prices of computers down to the point where individuals could buy them and led to the first flowering of the present computer revolution, the ascendancy of the software industry and the shift from "users will program them" to "users will run software packages", the Mac interface and its followers which brought the benefits ofcomputers to a far broader audience and fundamentally changed the way we use computers of all sizes and software of all kinds, and (to tread on dangerous ground since the event is relatively recent) the blossoming of the Internet. To sum up the history:

* Cheap Hardware
* Application Software
* Human Interface
* Internet

Forget operating systems as a significant part of the story, they are just a detail. Users would be better off if they never had to deal with one, and someday operating systems will disappear from view, just as the details of the processor (thankfully) have.

The future lies with getting rid of the cumbersome and complex systems we have now and moving to simpler, more direct methods of harnessing the power of the processor. See my article in Wired (cited above) for a bit more on the reasons for this.

Response from Bruce to Raskin's Letter

RE: RE: Xerox, Apple and Progress
      Response to Jef Raskin
By: Bruce Horn
      INFORMATICS CONSULTING

Jef Raskin's perspective on the origin of the Macintosh was very interesting. While Raskin doesn't actually contradict anything in my article apart from the origins of the internationalizable Software (Joanna Hoffman in the Mac group), I still feel that there are several corrections that need to be made.

My intention on writing the article was not to give individual credit to people for coming up with particular ideas. Rather, it was to show that the Mac was a different beast than the Xerox systems, a point that I believe I made clearly.

Raskin does have a few errors in his history and incorrectly quotes me as follows:

"Horn is correct that click-and-drag methods were invented at Apple and not at PARC (or elsewhere, as far as I know). I created this method for moving objects and making selections afterfinding the Xerox click-move-click method prone to error. Bill Atkinson extended the paradigm to pull-down menus."

This I did not say that in my article at all.

Xerox had click-and-drag in menus and for moving graphical objects long before Apple even existed as a company. In particular, Smalltalk-76 pop-up menus were click and drag. In my article I was talking about dragging files for file manipulation and drag & drop. PARC was a large organization with many groups doing research; it is not surprising that Raskin, as a visitor, did not see everything being done at PARC.

"Horn makes it seem that the selection-based editor came with Tesler from PARC. It may have been a case of convergent evolution, since we already had that paradigm at the Mac project. In this case it dates at least back."

Again, modeless selection-based graphical editing was in Tesler's Gypsy and Smalltalk-76, and predates Apple as a company. It is quite unlikely that Raskin's system at Bannister & Crun had much in common with the Smalltalk text editor.

"When Bruce Horn discusses the Hardware, and attributes the overall concept for the design to Jerry Mannock (who indeed did a world-class job on the final design of the box). Horn is unaware that the requirements for a small footprint, unique aesthetic, built-in Sound, etc. were all part of the project specs from the very beginning, long before Mannock joined the team."

I didn't attibute the overall concept to Jerry Manock, and I was indeed aware of Raskin's contribution. In my article I wasn't interested in attributing every innovation to an individual person. Jerry Manock and his group created the Mac look which is what I was discussing.

"Horn and many other people who joined Apple long after the Mac and Lisa projects were well under way never knew the genesis of many of the ideas the"

The Mac and Lisa both changed dramatically during the time I was at Apple. Many, if not most of the innovations that I mentioned were developed during that time.

Raskin also mentioned that the Star was "incredibly slow and somewhat clumsy to use..." I did have an opportunity in 1986 to try a Star and agree with his observations. However, when I said in the article that the Star was advanced I was indeed talking about the underlying system and ideas that went into the Star. The ideas have persisted and the architecture, while not visible to the user, was still quite sophisticated. I believe that to have a sophisticated and usable interface, the system has to be well thought-out also.

In addition to Raskin's list of articles that he has written about user interface, readers might be interested in looking up the Canon Cat, a computer of Raskin's design that was developed around the same time as the Mac. While it embodies many of Raskin's ideas, it bears almost no resemblance to the Mac at all. The Rolling Stone article (April 4, 1996) says that for the Mac, "Raskin was opposed to a mouse and a graphical user interface...and favored a squat design." It is clear that quite a bit happened after Raskin's departure from the Mac group.

I was very careful to attribute to Xerox and Apple only those innovations about which I felt reasonably certain I knew the origin. Raskin certainly is to be credited with the creation of the Macintosh concept; however, I believe that the details of the Mac implementation were developed after his departure. Raskin's commentary adds an interesting perspective on a very complex and interwoven time in computer history.

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